

What is claimed is:

1. A multi-functional admixture for concrete, said multi-functional admixture comprising Component A by 15-94 weight %, Component B by 5-84 weight % and

5 Component C by 0.1-5 weight % such that their total will be 100 weight %, wherein:

said Component A is one or more selected from the group consisting of graft copolymers obtained by a first process and a second process and salts of graft copolymers obtained further by a third process;

10 said first process is for obtaining copolymers with weight-average molecular weight of 5000-70000 by radical polymerization of a mixture of radical polymerizable monomers containing maleic anhydrides and monomers shown by Formula 1 by a total of 95 molar % or more at molar ratio of 50/50-70/30;

15 said second process is for obtaining graft copolymers by graft reaction of 100 weight parts of said copolymers obtained in said first process with 0.05-5.0 weight parts of polyether compounds shown by Formula 2;

said third process is for obtaining salts of graft copolymers by partially or completely neutralizing said graft copolymers obtained in said second process with one or more selected from the group consisting of alkali metal hydroxides, alkali earth metal hydroxides and amines;

20 said Component B is (poly)alkyleneglycol monoalkyl ether shown by Formula 3;

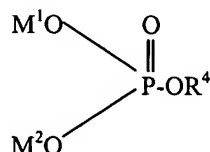
said Component C is organic phosphate shown by Formula 4 or Formula 5;

Formula 1 is given by  $\text{CH}_2=\text{CH}-\text{CH}_2-\text{O}-\text{A}^1-\text{O}-\text{R}^1$ ;

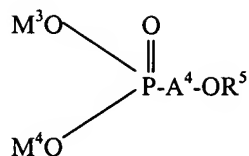
Formula 2 is given by  $\text{R}^2-\text{O}-\text{A}^2-\text{OH}$ ;

Formula 3 is given by  $\text{R}^3-\text{O}-\text{A}^3-\text{OH}$ ;

25 Formula 4 is given by



30 Formula 5 is given by



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where:

$\text{R}^1$  is methyl group, acetyl group or hydrogen atom;

$\text{R}^2$  is aliphatic hydrocarbon group with 8-20 carbon atoms;

10  $\text{A}^1$  is residual group obtained by removing all hydroxyl groups from (poly)alkyleneglycol with (poly)oxyalkylene group having in molecule only 1-150 oxyethylene units or a total of 2-150 oxyethylene units and oxypropylene units;

$\text{A}^2$  is residual group obtained by removing all hydroxyl groups from (poly)alkyleneglycol with polyoxyalkylene group having in molecule a total of 23-70 oxyethylene units and oxypropylene units that are added in blocks;

15  $\text{R}^3$  is alkyl group with 3-5 carbon atoms;

$\text{A}^3$  is residual group obtained by removing all hydroxyl groups from (poly)alkyleneglycol with (poly)oxyalkylene group having in molecule only 1-6 oxyethylene units or only 1-6 oxypropylene units, or a total of 2-8 oxyethylene units and oxypropylene units;

20  $\text{R}^4$  and  $\text{R}^5$  are each alkyl group with 8-18 carbon atoms;

$\text{A}^4$  is (poly)oxypropylene group with 1-5 oxypropylene units;

$\text{M}^1$ ,  $\text{M}^2$ ,  $\text{M}^3$  and  $\text{M}^4$  are each hydrogen atom, alkali metal, alkali earth metal, ammonium or organic amine.

25 2. The multi-functional admixture of claim 1 containing said Component A by 20-84 weight %, said Component B by 15-79 weight % and said Component C by 0.3-3 weight % such that their total will be 100 weight %.

30 3. The multi-functional admixture of claim 2 wherein said first process is for obtaining copolymers with weight-average molecular weight of 10000-50000 by radical

polymerization of said mixture of radical polymerizable monomers in the absence of solvent.

4. The multi-functional admixture of claim 3 wherein  $R^1$  is methyl group or  
5 acetyl group and  $A^1$  is residual group obtained by removing all hydroxyl groups from polyethyleneglycol with polyoxyethylene group having 10-90 oxyethylene units in molecule.

5. The multi-functional admixture of claim 3 wherein  $R^2$  is aliphatic  
10 hydrocarbon group with 10-20 carbon atoms and  $A^2$  is residual group obtained by removing all hydroxyl groups from polyalkyleneglycol with polyoxyalkylene group having in molecule a total of 25-60 oxyethylene units and oxypropylene units.

6. The multi-functional admixture of claim 3 wherein said second process is  
15 for obtaining graft copolymers by graft reaction of 100 weight parts of said copolymers obtained in said first process with 0.2-4 weight parts of polyether compounds shown by Formula 2.

7. The multi-functional admixture of claim 6 wherein said third process is for  
20 obtaining salts of graft copolymers by partially or completely neutralizing said graft copolymers obtained in said second process with alkali metal hydroxide.

8. The multi-functional admixture of claim 6 wherein said Component B is  
polyalkyleneglycol monoalkyl ether with polyoxypropylene group having only 2-4  
25 oxypropylene units in molecule.

9. The multi-functional admixture of claim 7 wherein said Component B is  
polyalkyleneglycol monoalkyl ether with polyoxypropylene group having only 2-4  
oxypropylene units in molecule.

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10. The multi-functional admixture of claim 6 wherein said Component C is organic phosphate shown by Formula 5 where  $R^5$  is alkyl group with 10-16 carbon atoms and  $M^3$  and  $M^4$  are each alkali metal.

5 11. The multi-functional admixture of claim 7 wherein said Component C is organic phosphate shown by Formula 5 where  $R^5$  is alkyl group with 10-16 carbon atoms and  $M^3$  and  $M^4$  are each alkali metal.

10 12. Concrete comprising 100 weight parts of cement and 0.1-5 weight parts of multi-functional admixture of claim 1.

13. Concrete comprising 100 weight parts of cement and 0.1-5 weight parts of multi-functional admixture of claim 6.

15 14. Concrete comprising 100 weight parts of cement and 0.1-5 weight parts of multi-functional admixture of claim 7.

15 15. The concrete of claim 12 which is AE concrete with entrained air content adjusted to be 3-6 volume %.

20 16. The concrete of claim 13 which is AE concrete with entrained air content adjusted to be 3-6 volume %.

25 17. The concrete of claim 14 which is AE concrete with entrained air content adjusted to be 3-6 volume %.